Sept. 8, 1953 A. WINTHER 2,651,732

ELECTROMAGNETIC VIBRATING CONTACT DEVICE AND CONTROL

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FIG. 2.

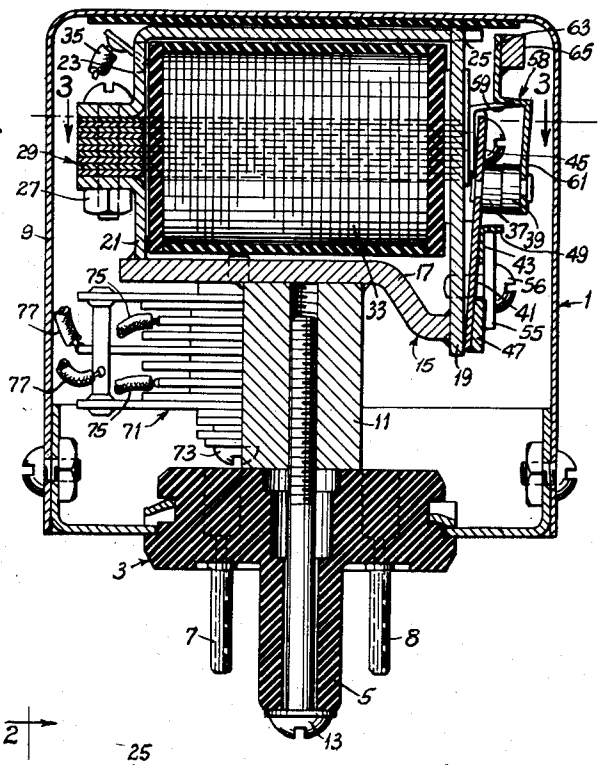


FIG. 1.

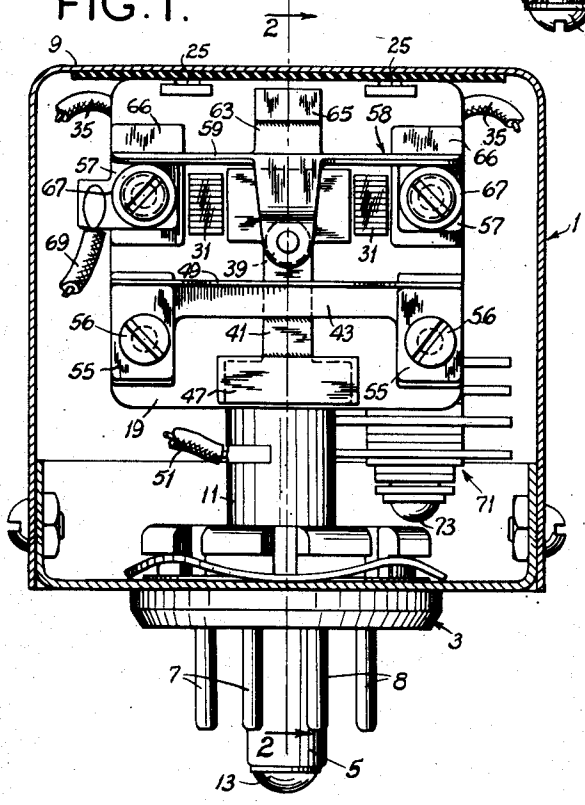
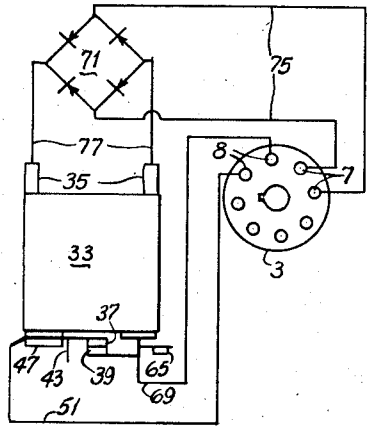


FIG. 5.



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FIG. 3.

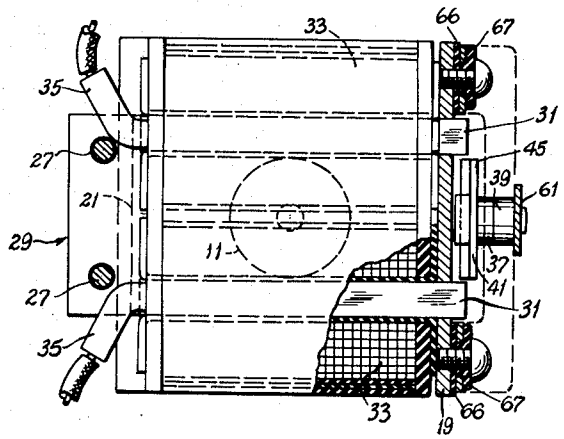


FIG. 4.

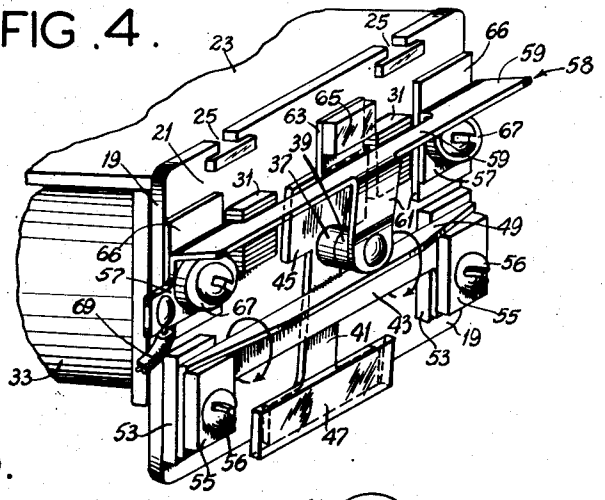
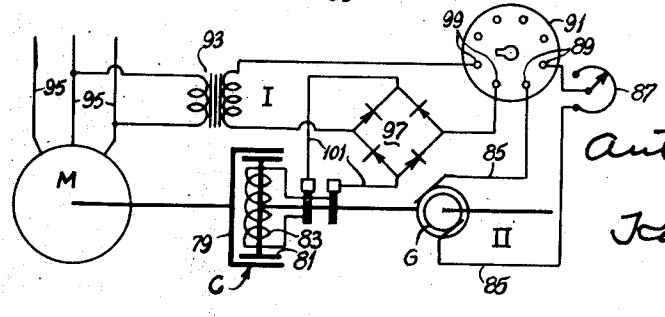


FIG. 6.



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Patented Sept. 8, 1953

2,651,732

UNITED STATES PATENT OFFICE

2,651,732

ELECTROMAGNETIC VIBRATING CONTACT DEVICE AND CONTROL

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Application November 30, 1951, Serial No. 259,114

5 Claims. (Cl. 310—95)

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This invention relates to electromagnetic vibrating contact devices and controls, and more particularly to such a device and control having a contact response that is sensitive to a varying amplitude, pulsating excitation but relatively insensitive to mechanical vibrations of the device as a unit.

In the U. S. patent application for Control System of Ralph L. Jaeschke, Serial No. 267,394, filed January 21, 1952, there is disclosed a control system incorporating an electromagnetic vibrating contact device, the control system being adapted to vary current supplied to a load in accordance with variations in a variable amplitude, pulsating control signal. Although other types of electromagnetic vibrating contact devices may be employed in this control system, the device of this invention is particularly adapted for such use. Accordingly, one of the objects of this invention is the provision of an electromagnetic vibrating contact device having a contact response to a pulsating excitation of considerable frequency, for example, of the order of several hundred cycles per second. Another object of this invention is the provision of a control unit for an electric machine which may be mounted directly upon the machine without responding excessively to its vibrations and which may readily be replaced.

In accomplishing these objectives, I have provided a plug-in unit incorporating an electromagnetic vibrating contact device having an electromagnet and a pair of switch contacts, one of which is a biased contact, movable in response to excitation of the electromagnet. A rectifier is preferably incorporated in the plug-in unit. The movable or vibratory contact is actuated and carried by an armature, which in turn is pivotally supported by means of a torsion bar and counterbalanced with respect to its pivotal axis. The other contact may be supported in like manner but without a magnetic armature. The torsion bars are torsionally resilient thin beams adapted to provide low resistance to twist and thereby high sensitivity to the electromagnet, but relatively high resistance to bending, particularly in the general direction of normal contact movement, and thereby low electrical sensitivity to mechanical vibrations of the unit as a whole. The complete control system is adapted to be mounted upon the controlled machine, with provision for replacement of control elements that are subject to wear. Other features will be in part apparent and in part pointed out hereinafter.

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The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a front view of the control unit of this invention, with a portion of its housing broken away;

Fig. 2 is a vertical section taken on line 2—2 of Fig 1;

Fig. 3 is a top plan view of the device, with the housing removed and parts broken away;

Fig. 4 is an enlarged oblique view illustrating certain contact assemblies;

Fig. 5 is a circuit diagram illustrating circuit connections of the control unit; and

Fig. 6 is a circuit diagram of control and controlled elements cooperable with the control unit of Fig. 5.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to Fig. 1 of the drawings, there is shown a self-contained, plug-in type control unit 1 having an insulated octal base 3 adapted for plugging cooperation with a suitable socket, such sockets being known in the art. The octal base 3 has an aligning key 5 and a series of conductive pins, two pairs of which are designated 7 and 8. Certain electrical control elements are supported upon the base 3 and a housing 9 is carried by the base to enclose these electrical elements. This housing should be substantially dustproof.

Extending upwardly from the insulated base 3 is a conductive metal post 11 which is fastened by means of a bolt 13 passed through the base 3 and threaded into the post 11. A conductive metal framework 15 is fastened to the top of the post, as by welding. This framework includes a platen 17, a face 19 welded across one end of the platen 17, and a flanged rear support 21 welded across the other end of the platen. A removable top 23 is secured to the face 19 by a tongue-and-slot arrangement 25 and to the rear support 21 by bolts 27. This frame encloses and supports an electromagnet, and accordingly is formed of non-magnetic material in order to avoid magnetic leakage.

The electromagnet comprises a U-shaped core 29 supported at its base between the frame mem-

bers 21 and 23 by the screws 27 and having spaced poles 31 which project through suitable openings in the face 19 of the frame. A pair of coils 33 is wound on the poles 31 and suitably insulated therefrom as shown. These coils 33 are connected together and have electrical connections 35 projecting through the top 23.

The electromagnet formed by the coils 33 and the core 29 is adapted to actuate one of two contacts supported from the face of the frame. As best shown in Fig. 4, there is an inner contact 37 which is adapted to open and close upon an outer contact 39. The inner contact 37 is carried upon a magnetic armature 41, which armature is supported as a cross member upon a torsion bar 43. The torsion bar 43 is in the form of a thin beam supported at its ends in spaced relation to the face 19 of the frame. As such, the torsion bar provides both a swinging support for the armature and spring means for imparting a bias to the armature.

The armature is formed of flat ferrous sheet metal of outline generally in the shape of an I, with an end portion 45 thereof extending between the poles 31 of the electromagnet and (as stated) carrying the inner contact 37. At its other end, the armature is counterbalanced by a weight 47 with respect to the pivotal axis of swinging movement of the torsion bar 43. That is, the moment of inertia of the armature in the plane of the armature on one side of its torsional axis is equal to that on the other side in order to prevent translatory acceleration from producing rotary movement of the armature. Such translation is of the type that usually occurs in response to vibration of the device as a whole.

The torsion bar 43 is of angle or inverted L-shaped cross section, with one leg 49 thereof extending in a horizontal plane generally in a direction normal to the face of the contact 37. This shape of the torsion bar is adapted to provide relatively low resilient resistance to twist and relatively high rigidity to bending in the general direction in which the contact 37 normally opens and closes upon the other contact 39. The assembly for the inner contact 37 is conductive and is in conductive relation with the frame 15 and its supporting post 11 to which latter a connection 51 is made. Electrical connection is made to the frame by spacer plates 53, backing plates 55 and screws 56 which are fastened to the face 19 to support the torsion bar 43 at its ends.

The outer contact 39 is mounted in a similar fashion, although it is unresponsive to the field of the electromagnet. A torsion type of support is obtained by forming a stamping 58 with mounting ears 57 at its ends, an elongate central beam 59 positioned in a horizontal plane and a tongue 61 bent downward generally in front of the inner contact 37, so that the outer contact 39 may be mounted on the tongue 61 for cooperating engagement with the contact 37. As before, counterbalancing means is provided by a tongue 63 bent upward and carrying a counterbalancing weight 65. The beam 59 functions to provide a relatively low resilience to twist or torsion and a relatively high bending resistance in the direction normal to the faces of the contacts. In this instance, an insulated type of support on the face 19 is provided by insulating spacer plates 66 and insulating bushings 67 sandwiching the ears 57 of the upper torsion element 58. A conductive lead 69 is fastened to one end of the element 58 as indicated.

In the device shown, the torsion elements bias the respective contacts against one another to a closed position and the electromagnet is adapted to move the inner contact away from the outer contact against this bias. It will be understood, however, that the contacts could be biased open and the electromagnet arranged to close the contacts.

In operation, a variable amplitude, pulsating D. C. current is employed to excite the coils 33. In one form of operation, such an exciting current is obtained from an A. C. generator feeding into a rectifier, the output of which is fed directly to the coil 33 without filtering other than that afforded by the inductance of the coils. The output of the rectifier then has a large ripple quantity of a frequency which, in the case of a full-wave rectifier, is twice the frequency of the generator output. When the device is adapted for such use, a rectifier may be mounted within the housing as shown at 71. A copper disc or selenium disc type of rectifier unit is employed, the unit being secured by a screw 73 to the platen 17 of the frame. As shown in Fig. 5, connections 75 are made from a pair of the conductive base pins 7 to the rectifier unit 71. This unit is arranged as a bridge rectifier with D. C. output connections 77 being made to the terminals 35 of the coil where they project from the rear of the relay frame.

A second circuit is provided through the switch contacts to another pair of the conductive pins 8. In this case, the outer contact 39 is connected through the conductive torsion bar 58 by the conductor 69 to one of the pins 8, and the inner contact 37 is connected to another pin 8 by means of a conductive relation through the armature 41, the associated torsion bar 43, the frame 15, the post 11 and the conductor 51.

In one application of this device, it is connected in a speed-control system for an electric machine of the type disclosed in the aforementioned patent application and in U. S. Reissue 22,432, dated February 1, 1944. Referring to Fig. 6 herein, there is diagrammatically shown a variable speed drive comprising an A. C. motor M and an electric coupling C. The coupling C may be an eddy-current slip coupling having a driving inductor member 79 mechanically coupled to the motor, and a driven field member 81 adapted for mechanical coupling to a load. The field member 81 carries a field coil 83 the excitation of which controls the slip at the coupling. The output speed of the drive is thereby controlled apart from the speed of the motor by varying the excitation of the field coil 83.

A control system incorporating the electromagnetic vibrating contact unit of this invention would include a power circuit I connected to excite the field coil 83 and a control circuit II adapted to excite the electromagnet of the device. An A. C. generator G is mechanically coupled to the driven field member to provide a signal proportional to the output speed of the drive. It has output connections 85 connected through an adjustable speed-setting resistor 87 to a pair of plugs 89 of an octal socket 91. This socket is adapted to cooperate with the octal base 3 mentioned heretofore. The power circuit I includes a transformer 93 connected to power supply lines 95 for the motor and through a bridge rectifier 97 to a second pair of plugs 99 of the octal socket 91. The D. C. output of the bridge is connected

at 101 through suitable brushes and slip rings to the field coil 83 of the coupling. It will be understood that all of the components M, C, G, 93, 87, 91, 93 and 97 shown in Fig. 6 may be arranged as a single unit within or in connection with a motor-clutch housing (see said Reissue 22,432).

The electromagnetic vibrating contact unit shown in Fig. 5 is adapted to have its base 3 plugged into the receptacle 91 shown in Fig. 6. In this event, the pair of pins 7 connects with the plugs 89 of the control circuit II; and the pair of pins 8 cooperates electrically with the plugs 99 in the power circuit I. As disclosed in the aforementioned copending patent application, the electromagnetic vibrating contact device operates to decrease the excitation of the field coil 83 and thereby increase the slip, when there is a tendency for the output speed of the coupling to increase with consequent increase in the output of the generator G. Speed regulation is thus obtained. As contrasted with some prior types of such controls, however, the operation of the control of this invention is not adversely affected by vibrations of the equipment, it being understood that the control system shown in Figs. 5 and 6 would be mounted upon the machine constituted by the motor M, clutch C and generator G (see said Reissue 22,432). The transformer 93, the generator G and the rectifiers 97 and 71 are all unresponsive to mechanical vibrations. Only the switch contacts 37, 39 would respond to such mechanical vibrations in such a control, and the unit herein is so constructed that translatory vibrations of the unit per se do not affect the operation of the contacts 37, 39. The housing 9 protects the contacts from dust, but in the event of a breakdown in the contacts or rectifier 71, replacement is readily accomplished.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. An electromagnetic vibrating contact device comprising a frame, an electromagnet carried by the frame, an elongate magnetic armature pivotally suported upon the frame with one end of the armature adjacent the electromagnet for actuation thereby, said armature being supported as a cross member upon a first torsion element and said torsion element being mounted at its ends upon the frame, a first contact carried by the armature on one side of its pivotal axis and a counterbalancing weight carried by the armature on the other side of its pivotal axis, a second torsion element having spaced supports, a contact carrying member projecting radially therefrom and carrying a second contact cooperable with the first contact, and a counterbalancing member projecting from the second torsion element in a direction opposite from that of said contact carrying member.

2. A self-contained variable-speed drive unit comprising a motor supplied from A. C. power lines, an electric coupling driven by the motor, the coupling having a field coil, an A. C. generator

driven by the coupling, a first rectifier and a pair of contacts resiliently supported and connected between the A. C. power lines and the field coil of the coupling, a magnetic armature pivotally suported on the unit for actuating one of said contacts, said armature being counterbalanced with respect to its pivotal axis against linear vibrations in the general direction of normal contact movement, an electromagnet for actuating said armature, and a second rectifier connecting said electromagnet with the A. C. generator, all of said elements being suported as a unit.

3. Apparatus as set forth in claim 2, wherein the electromagnet, the contacts and the second rectifier are contained in a dust-proof plug-in unit, and wherein the first rectifier and generator are electrically connected to a socket cooperable with said plug-in unit.

4. In a self-contained variable-speed drive unit comprising a motor supplied from A. C. power lines, an electric coupling driven by the motor and having a field coil, an A. C. generator driven by the coupling, the field coil of the coupling being connected to the A. C. power lines through rectifier means; a speed control suported upon the drive unit comprising a pair of resiliently-supported contacts connected between said A. C. power lines and said rectifier means, a magnetic armature pivotally supported on the unit for actuating one of said contacts, said armature being counterbalanced with respect to its pivotal axis against linear vibrations in the general direction of normal contact movement, an electromagnet for actuating said armature, and second rectifier means connecting said electromagnet with the A. C. generator.

5. A self-contained variable-speed drive unit comprising a motor supplied from A. C. power lines, an electric coupling driven by the motor, the coupling having a field coil, an A. C. generator driven by the coupling, a first rectifier and a pair of contacts one of which is resiliently supported and connected between the A. C. power lines and the field coil of the coupling, a magnetic armature pivotally supported on the unit for actuating said resiliently supported contact, an electromagnet for actuating said armature, a second rectifier connecting said electromagnet with the A. C. generator, a protective plug-in unit containing said electromagnet, the contacts and the second rectifier, and means electrically connecting the first rectifier and the generator to a socket with which said plug-in unit is cooperable.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
803,480	Seeley	Oct. 24, 1905
1,271,535	Bijur	July 9, 1918
2,099,250	Adler	Nov. 16, 1937
2,231,174	Trogner	Feb. 11, 1941
2,339,676	Bucklen, Jr.	Jan. 18, 1944
2,410,183	Ray	Oct. 29, 1946
2,454,060	Hegy	Nov. 16, 1948
2,475,820	Coake	July 12, 1949
2,499,632	Coake	Mar. 7, 1950
2,534,354	Keller	Dec. 19, 1950
2,538,020	Lomholt	Jan. 16, 1951
2,546,284	Weisbecker	Mar. 27, 1951